Opera-3d High Frequency EM Module

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Opera Simulation Software

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Opera-3d contains a high-frequency analysis module, which solves the full wave equation. This includes displacement currents for devices comparable in size to the wavelength at its operating frequency.

In Opera-3d's High Frequency EM Module, two types of analysis are possible; an eigenfrequency analysis to determine the modes of a resonant cavity, and steady-state to solve the equations at pre-defined frequencies. The programs incorporate state of the art algorithms to calculate electromagnetic fields and advanced finite element numerical analysis procedures.

The Eigenvalue Solver:

The Eigenvalue solver solves resonant cavity models containing lossless, isotropic dielectrics. It treats the walls of a cavity as perfect electrical conductors (PEC) which is a good approximation at high frequency. The Eigenvalue solver finds the eigenvalues above a given frequency, or within a specified range using a direct solution method. It uses optimal re-ordering methods to minimize the memory requirements.

For eigenvalue problems, modelling re-entrant corners is crucial and special care has been taken to represent such features accurately. Although the module assumes all conducting walls are ideal conductors, users can obtain the surface current density distribution, as well as Q-factor calculations for practical materials. The post processor also displays the E and H fields associated with these resonant modes.

The Steady-State Solver:

The Steady-state solver, like the eigenfrequency solver, uses edge elements to solve the wave equation in terms of the electric field. It defines non-zero boundary conditions in terms of magnetic vector potential or electric field strength.

It solves the full Helmholtz equation, including loss and propagation terms, and the resulting complex solution can provide results at any time in the ac cycle (including time average and RMS quantities).

The module uses boundary conditions in three ways. Firstly, they provide a way of reducing the size of models by exploiting symmetry. Secondly, they approximate the field at large distances from the model (far-field boundaries). Thirdly, they may be used as driving terms. Options offered include:

- Absorbing boundary condition with user defined wave impedance.
- Incident and total electric field boundary condition.
- Current source boundary condition.

The first of these provides field termination, and the other two may be used to excite a device.

The absorbing boundary condition effectively absorbs all energy incident upon it and does not reflect the energy back into the system. In addition to these, surface impedance boundary conditions allows efficient modelling of material of high, but finite, conductivity. Users can deploy both high frequency simulation modules as stages in Opera-3d's powerful multiphysics tools, allowing inclusion of thermal and structural effects.

Modeller and Post Processor

As a module of the Opera-3d suite of software, the high-frequency analysis module interfaces to the Opera-3d Modeller and Post Processor. This gives the user access to powerful pre and post processing features specifically tailored for electromagnetic and cavity design.

The Modeller allows users to create models, define material properties, set boundary conditions and excitations, create the mesh and launch the calculation. It allows the user to build models from primitive shapes using Boolean operations, or to import geometry from other CAD programs for which a range of I/O filters is available. Material data can be input by the user. The Opera-3d automatic mesh generator has facilities for creating hexahedral, prism and tetrahedral meshes, requiring little or no user setting in many cases. However, it does include facilities to finely control the mesh when required.

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Solutions are stored in a database that can be interrogated using the Post Processor. The post processor is renowned for its versatility in displaying computed results. It has very comprehensive and flexible facilities enabling results to be displayed in a variety of ways controlled by an easy to use 'windows' interface.

Applications:

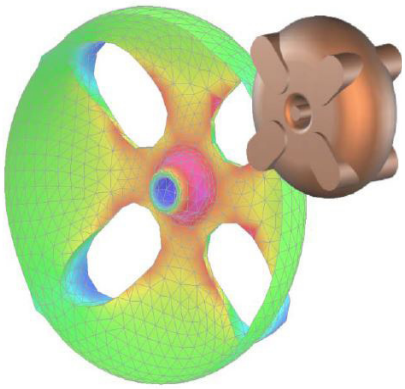
- RF cavities
- Microwave structures
- Oil exploration tools
- Remote sensing in undersea applications

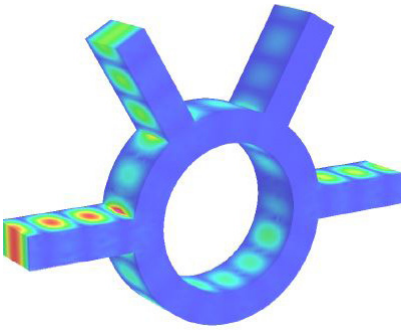
Tools:

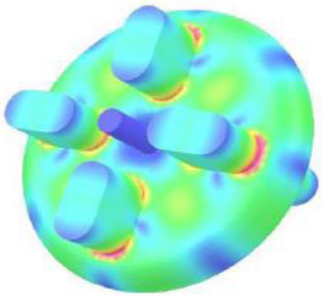
- Full 3d modelling
- Automatic Mesh Generation
- Interfaces to CAD
- Steady-state or Eigenvalue analysis
- Generalized boundary conditions
- User defined functions

Results Processing:

- Eigenvalue display as contours or vectors
- Graphs & histograms of the solution
- Results calculated on any surface
- Surface and volume integrals
- Q factor calculations
- Shunt impedance values
- Extendable Post-Processing







Customer Support

We provide support to Opera users from our offices in the UK and the USA, and through a worldwide network of local representatives. Our support engineers have an extensive knowledge of EM analysis and applications, and are available to assist both existing and prospective customers with their design requirements.

For more information about Opera and multi-physics simulation for EM devices and systems, please refer to our website operaFEA.com. This includes links to application specific websites that contain information, including a range of technical publications, videos and webinars, of interest to engineers and scientists involved in electromagnetic design and analysis.

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